

**WHAT IS CLAIMED IS:**

- 1           1.       An access control system, comprising:  
2           an object detector configured to detect persons present within a detection  
3           area;  
4           a token reader configured to interrogate tokens present within a token  
5           reader area; and  
6           an access controller configured to receive signals from the object detector  
7           and the token reader, and configured to compute one or more characteristics  
8           linking persons and tokens based upon signals received from the object detector  
9           and the token reader and to determine whether each detected person is carrying a  
10          permissioned token based upon the one or more computed characteristics linking  
11          persons and tokens.
- 1           2.       The system of claim 1, wherein the one or more computed  
2           characteristics linking persons and tokens correspond to counts of persons and  
3           tokens.
- 1           3.       The system of claim 2, wherein the access controller is configured to  
2           tally a count of persons based upon signals received from the object detector and  
3           to tally a count of tokens based upon signals received from the token reader.
- 1           4.       The system of claim 3, wherein the access controller is configured to  
2           generate a signal based upon a comparison of the persons count and the tokens  
3           count.
- 1           5.       The system of claim 4, wherein the access controller is configured to  
2           generate a signal when the persons count differs from the tokens count.
- 1           6.       The system of claim 4, wherein the access controller is configured to  
2           generate an access granted signal when the persons count is less than or equal to  
3           the tokens count.
- 1           7.       The system of claim 1, wherein the object detector is configured to  
2           track one or more persons within the detection area over time.

1           8.     The system of claim 7, wherein the object detector is a vision-based  
2 person tracking system.

1           9.     The system of claim 8, wherein the object detector comprises a  
2 video system configured to generate depth video streams from radiation received  
3 from the detection area, and a processing system configured to detect and track  
4 objects based at least in part upon data obtained from the depth video streams.

1           10.    The system of claim 9, wherein the object detector is operable to:  
2           generate a three-dimensional point cloud having members with one or  
3 more associated attributes obtained from the time series of video frames and  
4 representing selected depth image pixels in a three-dimensional coordinate system  
5 spanned by a ground plane and a vertical axis orthogonal to the ground plane;  
6           partition the three-dimensional point cloud into a set of vertically-oriented  
7 bins;  
8           map the partitioned three-dimensional point cloud into at least one plan-  
9 view image containing for each vertically-oriented bin a corresponding pixel  
10 having one or more values computed based upon one or more attributes of the  
11 three-dimensional point cloud members occupying the corresponding vertically-  
12 oriented bin; and  
13          track the object based at least in part upon the plan-view image.

1           11.    The system of claim 7, wherein movements of detected persons  
2 within the detection area are time-stamped.

1           12.    The system of claim 1, wherein the token reader is configured to  
2 wirelessly interrogate tokens within the token reader area.

1           13.    The system of claim 1, wherein the one or more computed  
2 characteristics linking persons and tokens correspond to measures of separation  
3 distance between persons and tokens.

1           14.    The system of claim 11, wherein the access controller is configured  
2 to generate a signal when a detected person is separated from a nearest token by  
3 a distance measure that exceeds a preselected threshold.

1           15.     An access control method, comprising:  
2           detecting persons present within a detection area;  
3           interrogating tokens present within a token reader area;  
4           computing one or more characteristics linking persons and tokens based  
5           upon results of the detecting and interrogating steps; and  
6           determining whether each detected person is carrying a permissioned  
7           token based upon the computed characteristics linking persons and tokens.

1           16.     The method of claim 15, wherein the one or more computed  
2           characteristics linking persons and tokens correspond to counts of persons and  
3           tokens.

1           17.     The method of claim 16, further comprising tallying a count of  
2           persons, and tallying a count of tokens.

1           18.     The method of claim 17, further comprising generating a signal  
2           based upon a comparison of the persons count and the tokens count.

1           19.     The method of claim 18, further comprising generating a signal  
2           when the persons count differs from the tokens count.

1           20.     The method of claim 18, further comprising generating an access  
2           granted signal when the persons count is less than or equal to the tokens count.

1           21.     The method of claim 15, further comprising tracking one or more  
2           persons within the detection area over time.

1           22.     The method of claim 21, wherein tracking comprises generating  
2           depth video streams from radiation received from the detection area, and  
3           detecting and tracking objects based at least in part upon data obtained from the  
4           depth video streams.

1           23.     The method of claim 22, wherein tracking comprises:  
2           generating a three-dimensional point cloud having members with one or  
3           more associated attributes obtained from the time series of video frames and  
4           representing selected depth image pixels in a three-dimensional coordinate system  
5           spanned by a ground plane and a vertical axis orthogonal to the ground plane;

6           partitioning the three-dimensional point cloud into a set of vertically-  
7 oriented bins;  
8           mapping the partitioned three-dimensional point cloud into at least one  
9 plan-view image containing for each vertically-oriented bin a corresponding pixel  
10 having one or more values computed based upon one or more attributes of the  
11 three-dimensional point cloud members occupying the corresponding vertically-  
12 oriented bin; and  
13           tracking the object based at least in part upon the plan-view image.

1           24.   The method of claim 21, further comprising time-stamping  
2 movements of detected persons within the detection area.

1           25.   The method of claim 15, wherein the token reader is configured to  
2 wirelessly interrogate tokens within the token reader area.

1           26.   The method of claim 15, wherein the one or more computed  
2 characteristics linking persons and tokens correspond to measures of separation  
3 distance between persons and tokens.

1           27.   The method of claim 26, further comprising generating a signal  
2 when a detected person is separated from a nearest token by a distance measure  
3 that exceeds a preselected threshold.

1           28.   A machine-readable medium storing machine-readable instructions  
2 for causing a machine to:  
3           detect persons present within a detection area;  
4           interrogate tokens present within a token reader area;  
5           compute one or more characteristics linking persons and tokens based  
6 upon results of the detecting and interrogating steps; and  
7           determine whether each detected person is carrying a permissioned token  
8 based upon the computed characteristics linking persons and tokens.

1           29.   The medium of claim 28, wherein the one or more computed  
2 characteristics linking persons and tokens correspond to counts of persons and  
3 tokens.

1           30.     The medium of claim 28, wherein the one or more computed  
2     characteristics linking persons and tokens correspond to measures of separation  
3     distance between persons and tokens.

1           31.     The medium of claim 28, further comprising tracking one or more  
2     persons within the detection area over time.

1           32.     The medium of claim 30, wherein tracking comprises generating  
2     depth video streams from radiation received from the detection area, and  
3     detecting and tracking objects based at least in part upon data obtained from the  
4     depth video streams.

1           33.     An access control method, comprising:  
2             visually tracking a person;  
3             determining whether the tracked person has a permissioned token based  
4     on one or more characteristics linking persons and tokens; and  
5             generating a signal in response to a determination that the tracked person  
6     is free of any permissioned tokens.

1           34.     An access control method, comprising:  
2             detecting tokens crossing a first boundary of a first area;  
3             tallying a count of tokens in the first area based on the tokens detected  
4     crossing the first boundary;  
5             detecting persons crossing a second boundary of a second area;  
6             tallying a count of persons in the second area based on the persons  
7     detected crossing the second boundary; and  
8             generating a signal in response to a determination that the persons count  
9     exceeds the tokens count.

1           35.     The method of claim 34, wherein detecting tokens comprises  
2     detecting tokens crossing the first boundary into and out of the first area.

1           36.     The method of claim 35, wherein tallying a count of tokens in the  
2     first area comprises subtracting a count of persons crossing the first boundary out  
3     of the first area from a count of persons crossing the first boundary into the first  
4     area.

1           37.     The method of claim 34, wherein detecting persons comprises  
2     detecting persons crossing the second boundary into and out of the second area.

1           38.     The method of claim 37, wherein tallying a count of persons in the  
2     second area comprises subtracting a count of persons crossing the second  
3     boundary out of the second area from a count of persons crossing the second  
4     boundary into the second area.

1           39.     An access control system, comprising:  
2             a token reader configured to detect tokens crossing a first boundary of a  
3     first area;  
4             an object detector configured to detect persons crossing a second boundary  
5     of a second area; and  
6             an access controller configured to tally a count of tokens in the first area  
7     based on the tokens detected crossing the first boundary, tally a count of persons  
8     in the second area based on the persons detected crossing the second boundary,  
9     and generating a signal in response to a determination that the persons count  
10    exceeds the tokens count.

1           40.     A machine-readable medium storing machine-readable instructions  
2     for causing a machine to:  
3             detect tokens crossing a first boundary of a first area;  
4             tally a count of tokens in the first area based on the tokens detected  
5     crossing the first boundary;  
6             detect persons crossing a second boundary of a second area;  
7             tally a count of persons in the second area based on the persons detected  
8     crossing the second boundary; and  
9             generate a signal in response to a determination that the persons count  
10    exceeds the tokens count.